November 14, 1978/T. L. Collins

HIGH-BETA STRAIGHT SECTIONS FOR THE DOUBLER

I propose that we build two special long straight sections in the Doubler, at F and A, which have large horizontal beta (∿225 M) at the upstream end of the clear space - and a relatively small vertical beta (∿34 M) at the same place. A suitable magnet arrangement is shown in the diagram.

The following should be noted:

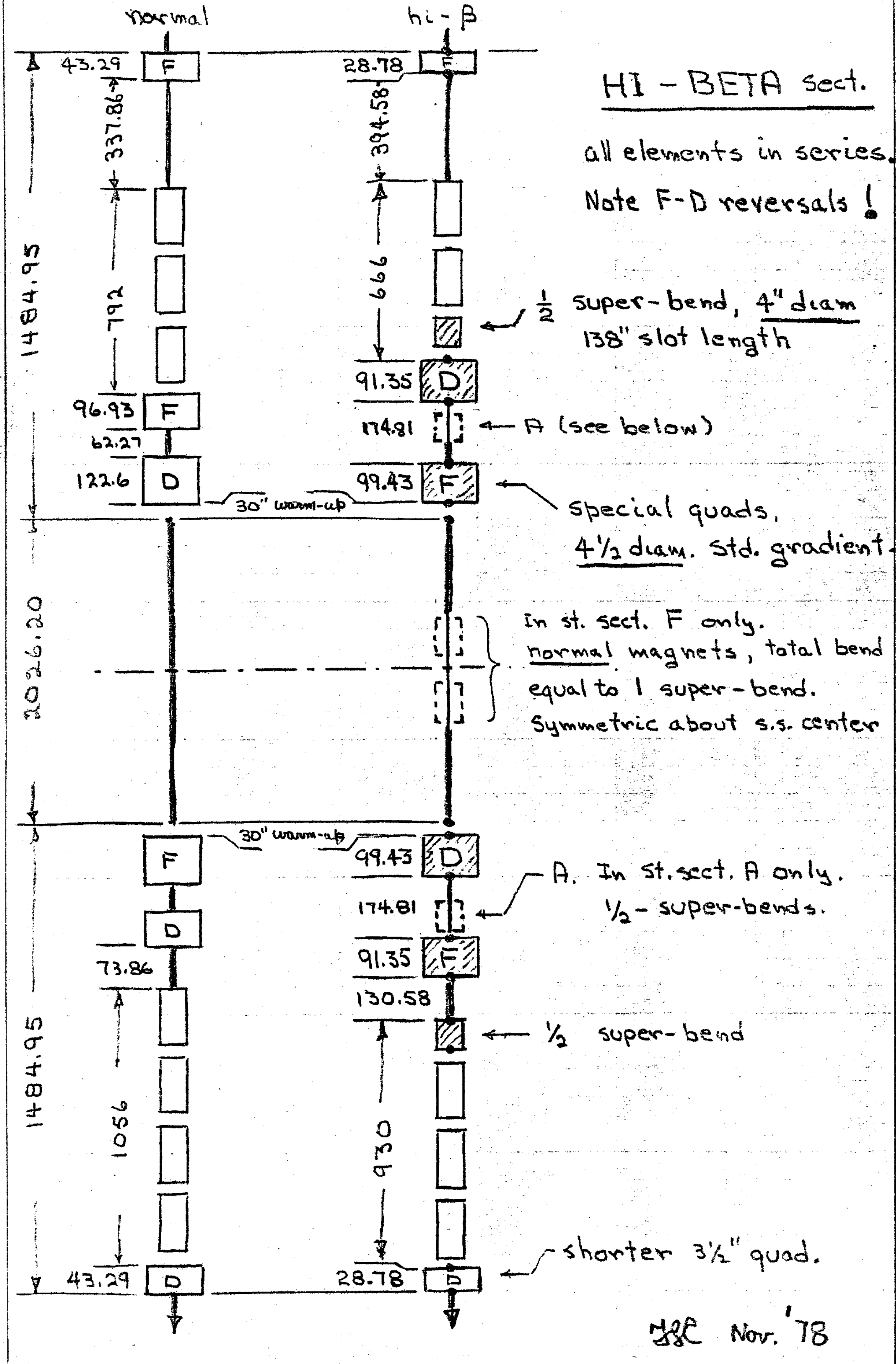
a) The F and D of each doublet are reversed from normal. This is a permanent change of structure. One cannot inject into the previous symmetric lattice and "turn-on" the special properties when needed as in the case of "adiabatic" low-beta sections. Because it is permanent, I have designed the lattice for normal series excitation.

b) To make space for the doublet, I have removed 1/2-magnet from each side. In straight section F this bending is replaced in the center of the long straight section as normal - not superconducting - magnets. This allows shielding of downstream superconducting magnets from radiation from protons hitting septum wires. In straight section A, where clear space is at a premium, the bending is replaced by 1/2-magnets (superconducting) between doublet elements. The position of the remaining magnets has been juggled so that the survey orbit will close when the bending is replaced symmetrically about the straight-section center.

c) It is easy to obtain a higher beta, it requires weaker elements. This choice is consistent with excursions in the enlarged dipoles and quads in proption to excursions in normal elements.

The effect of this change on extraction is dramatic. In addition to providing a good shielding mechanism, it allows extraction with a back-of-septum orbit not greater than .8" and jump-to-amplitude ratio the same as main-ring extraction. To obtain the same relative performance in the present lattice one would need 5" bore magnets! The high horizontal beta and low-vertical beta greatly enhances the magnet septum performance, which helps solve the extraction channel design problem.

I enthusiastically recommend adoption of this lattice.



normal
hi-β
HI-BETA sect.
all elements in series.
Note F-D reversals!
43.29
F
337.86
28.78
394.58
1484.95
792
666
½ super-bend, 4" diam
138" slot length
91.35
D
96.93
F
174.81
A (see below)
62.27
122.6
D
99.43
F
30" warm-up
special quads,
4½ diam. Std. gradient.
2026.20
In st. sect. F only.
normal magnets, total bend
equal to 1 super-bend.
Symmetric about s.s. center
30" warm-up
F
99.43
D
A. In st. sect. A only.
½ - super-bends.
174.81
D
91.35
F
73.86
130.58
½ super-bend
1484.95
1056
930
shorter 3½" quad.
43.29
D
28.78
D
Nov. '78

	β_H inches	α_H	φ_H deg.	β_V inches	α_V	φ_V deg
	3854	-1.8703	0	1149	.5846	0
28.78 QF						
	3917	-.311	.42	1129	.095	1.45
1060.58						
	4891	-.608	14.45	1932	-.852	47.33
91.35 QD						
	5611	-7.578	15.46	1865	1.560	50.04
* → 174.81						
	8579	-9.399	16.91	1376	1.238	56.30
** 99.43 QF						
	9238	3.081	17.53	1326	-.711	60.62
warm-up 30						
	9054	3.0471	17.72	1370	-.745	61.90
clear: 1,013.1						
clear: center	4046	1.896	27.36	4046	-1.896	87.39
clear: 1013.1						
	1370	.745	52.85	9054	-3.047	97.03
warm up 30						
	1326	.711	54.13	9238	-3.081	97.21
99.43 QD						
	1376	-1.238	58.45	8579	9.399	97.84
174.81						
	1865	-1.560	64.71	5611	7.578	99.28
91.35 QF						
	1932	.852	67.42	4891	.608	100.30
1060.58						
	1129	-.095	113.30	3917	.311	114.33
28.78 QD						
	1149	-.5846	114.75	3854	1.8703	114.75

* ½-bend in A. $\beta_H = 5794 \rightarrow 7901''$

** max. $\beta_H = 9311''$

β_0 (in normal cell F quad) = $3921''$

Two hi-β sections lower ν_x and ν_y by .021, and add a 17" betatron-like oscillation to η.

PHASE-AMP FUNCTIONS in HI-BETA SECTIONS

JLC Nov '78